Beef Consumption is Positively Correlated to Mid-Arm Muscle Area in Older Adults in Ohio

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ABSTRACT

Background: Older adults are at risk of developing sarcopenia, the loss of muscle mass during aging. This condition can increase disability and decrease function, strength, and quality of life. Additionally, older adults are at risk of nutritional deficiencies such as protein, vitamin B_{12}, and zinc. Beef is a naturally nutrient-rich food that may help to prevent some of these health concerns.

Objective: To determine the relationship of beef intake to nutrition status, body composition, strength, and biochemical measures of vitamin and mineral status, inflammation and blood lipids in older adults in Ohio.

Design: 142 older adults completed a Diet History Questionnaire, and questionnaires related to nutrition status, activity, and mental status. Subjects also underwent measurements of body composition and strength, and a subset took part in a blood draw to determine biochemical measurements.

Results: Beef intake was positively correlated to muscle mass as measured by mid-arm muscle area (cm^2) (R = 0.128, *P* = 0.030), and was not associated with overall nutrition status as measured by the Mini Nutrition Assessment (MNA), or other measurements of body composition and strength. Beef consumption was not associated with biochemical measures of zinc, vitamin B_{12}, or inflammation. Beef intake was negatively correlated to total (R = - 0.179, *P* = 0.035) and HDL (R = -0.247, *P* = 0.004) cholesterol but not LDL cholesterol or triglycerides.

Conclusions: Beef intake was positively associated with mid-arm muscle area, a predictor of muscle mass, in older Ohioans. Consuming beef in moderation may be a healthy way in which older adults can preserve muscle mass and decrease the risk of sarcopenia.

BACKGROUND AND SIGNIFICANCE

•Older adults are the most rapidly growing segment of the population in the United States. Older adults are expected to constitute 19.6% of the population by the year 2030 (Centers for Disease Control).

•Older adults are at increased risk of protein deficiency as well as zinc and vitamin B_{12}.

•One-third of people over the age of 60 are not consuming the recommended 0.8 grams of protein per kilogram body weight per day (USDA Survey of Food and Nutrient Intakes by Individuals).

•Adequate dietary protein may help preserve muscle mass, which progressively decreases with increasing age. This decrease in muscle mass, termed sarcopenia, has been associated with decreased functional status, increased disability, and decreased quality of life (1).

•Beef is a high source of all of these nutrients. A three-ounce serving of beef provides 50% RDA for protein, 39% RDA for zinc, and 37% RDA for vitamin B_{12}. Beef is a naturally nutrient-dense food that may potentially help older adults decrease their risk of several nutrient deficiencies.

RESEARCH SUPPORT

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SUBJECTS AND METHODS

Subjects: 142 ambulatory, free-living older adults from Ohio between the ages of 60 and 88. Biochemical measures were completed on 56 subjects.

Methods:

Dietary Intake
- Diet History Questionnaire (DHQ)

Nutrition Status
- Mini Nutrition Assessment (MNA)

Anthropometry
- Height (cm), Weight (kg), BMI (kg/m^2)
- Midarm Circumference (MAC, cm)
- Triceps Skinfold (TSF, mm)
- Midarm Muscle Area (MAMA, cm^2)
  - MAMA equations:
    - Females: $[(MAC - \pi \times TSF)^2 / 4\pi] - 6.5$
    - Males: $[(MAC - \pi \times TSF)^2 / 4\pi] - 10.0$
- Calf circumference (CC, cm)
- Sagittal abdominal diameter (SAD, cm)

Activity
- Modified Baecke Questionnaire for Older Adults
- Pedometer

Strength
- Handgrip strength (kg)

Mental Status
- Short Orientation-Memory-Concentration Test
- Geriatric Depression Scale
- Perceived Stress Scale
- Perceived Social Support Scale

Biochemical Measurements
- Vitamin B^{12} status (serum vitamin B_{12})
- Zinc status (plasma zinc, 5'-nucleotidase)
- Blood lipids (TC, LDL, HDL, TG)
- Liver enzymes (AST, ALT)
- Inflammation (TNF-α, IL-6).

Statistical Analysis
- •Kendall's tau (non-parametric correlation coefficient used for abnormal data distribution) - correlations of the various parameters to beef consumption
- •Pearson's correlation coefficient - correlations of the various parameters to protein intake
- •Multiple linear regression models - relationship between beef consumption, protein intake, and various health outcome measures

Response Variable	Correlation with Beef Intake	P-value
MNA	-0.019	0.751
BMI (kg/m^2)	0.056	0.328
CC (cm)	0.053	0.354
SAD (cm)	0.076	0.186
MAMA (cm^2)	**0.128**	**0.030***
Handgrip (kg)	0.052	0.365
TC (mg/dl)	**-0.179**	**0.035***
HDL (mg/dl)	**-0.247**	**0.004***
LDL (mg/dl)	-0.146	0.084
ALT (U/L)	0.139	0.112
AST (U/L)	-0.019	0.828
IL-6 (pg/ml)	0.055	0.556
TNF-α (pg/ml)	0.009	0.921
Vitamin B_{12} (pg/ml)	-0.121	0.153
Zinc (µg/ml)	-0.048	0.606
5'-Nucleotidase (U/L)	-0.003	0.997
Hemoglobin (g/dl)	0.092	0.280
Ferritin (ng/ml)	-0.091	0.350
Transferrin Receptor (nmol/ml)	0.159	0.086
Response Variable	**Correlation with Protein Intake**	**P-value**
MNA	**0.196**	**0.020***
CC (cm)	**0.190**	**0.024***

TABLE 1: Correlations of beef and protein intakes to anthropometric, strength, and biochemical measurements collected from older adults in Ohio. Beef intake remained significantly and positively correlated to mid-arm muscle area after accounting for the effects of %Kcal from protein, age, gender, and activity level (p=0.042) in one model, and the effects of %Kcal from protein and consumption of total meat, fish and poultry (p=0.003) in another model. Percentage of Kcal from protein remained significantly and positively correlated to MNA after accounting for beef intake, age, gender, race, and stress (p=0.031), and calf circumference after accounting for beef intake, age, gender, activity, race, and stress (p=0.004).

RESULTS

	N	Mean	SD	Minimum	Median	Maximum
Age	142	73.3	6.7	60	73.5	88
Beef (oz/d)	142	0.79	0.77	0.04	0.52	3.86
Energy (kcal)	142	1702	758	269	1582	4516
% kcal from protein	142	15.5	2.7	9.3	15.4	23.7
MNA	141	27.5	2.0	18.5	28.0	30.0
BMI (kg/m^2)	142	28.0	4.9	16.5	27.0	42.9
CC (cm)	141	38.1	3.6	30.8	37.5	50.8
SAD (cm)	139	21.6	3.6	14.5	21.4	33.0
HG (kg)	142	26.9	9.3	11.0	25.0	53.0
MAMA (cm^2)	131	36.5	11.9	14.4	34.4	74.4
Pedometer (steps)	132	5724	3320	267	5202	18034
Depression	142	1.2	1.8	0	1	9
Social Support	141	71.8	12.3	11	75	84
Stress	142	18.4	7.5	3	18	35
Baecke	142	9.9	7.2	1.0	8.6	49.5

TABLE 2: Descriptive summary of data collected from older adults in Ohio

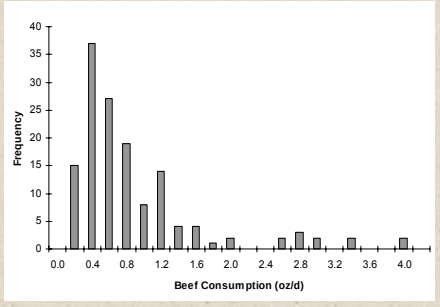

FIGURE 1: Histogram of average daily beef consumption of older adults in Ohio as measured by the Diet History Questionnaire

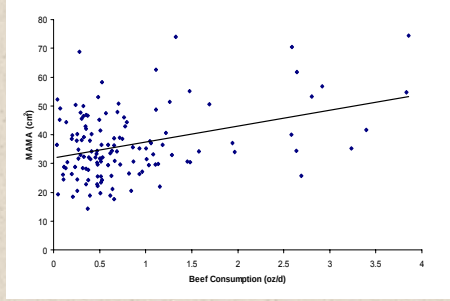

FIGURE 2: Scatterplot of the relationship between average daily beef consumption and mid-arm muscle area for older adults in Ohio (R=0.128, p=0.030).

CONCLUSIONS

Mid-arm muscle area (MAMA) was significantly and positively correlated to beef consumption in older adults, even after accounting for the effects of protein intake, age, gender, activity and consumption of all meat, fish, and poultry. In contrast, beef consumption was not associated with changes in biochemical markers or anthropometric measurements. Calf circumference and MNA scores, although not correlated to beef consumption, were correlated to percentage of kilocalories consumed in the form of protein.

Dietary guidance from health professionals working with older adults has advocated limiting red meat consumption, thus restricting the variety of protein sources available to those who choose to follow a healthy diet. Previous research suggests that diets including moderate amounts of lean beef do not increase risk of chronic disease (2) and therefore indicate that beef can be encouraged as one option for meeting protein needs. Beef is a naturally nutrient-rich food that can be included in the diet in moderation for older adults. Our study supports this recommendation by demonstrating that red meat may aid in maintaining muscle mass, without adversely affecting other biochemical or anthropometric measurements in older adults.

REFERENCES

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